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Catheter insertion device

The invention relates to a catheter insertion device according to the preamble of claim 1.

A device of this kind is known from EP 352 928, wherein in a hollow catheter hub a needle guard element is arranged. On withdrawal of the hollow needle from the catheter over an engaging means near the tip of the hollow needle, the needle guard element engages with the engaging means and covers the tip when the hollow needle is separated from the catheter. In this design, after withdrawal of the hollow needle from the catheter, through this catheter blood can issue with which the operating personnel can come into contact.

The invention is based on the object of designing a catheter insertion device of the type described above such that an outflow of blood from the catheter is prevented after removal of the hollow needle with the needle guard element.

This object is solved according to the invention by the features in the characterizing part of claim 1. In the ready position, a check valve is arranged in the catheter hub between the catheter and the needle guard element. Through this valve the hollow needle extends, so that after withdrawal of the hollow needle from the catheter the latter can be reliably closed such that an outflow of blood is prevented, while simultaneously the tip of the hollow needle is securely covered by the needle guard element so that the operating personnel cannot injure themselves on the needle tip.

Exemplary embodiments of the invention are explained in more detail below with reference to the drawing, in which

Fig. 1 shows a longitudinal section through a catheter insertion device in the ready position,
Fig. 2 shows the catheter insertion device with the hollow needle removed,
Fig. 3 shows the device with an attached syringe,
Fig. 4 shows a sectional view along the line A-A in Fig. 1,

Fig. 5 shows a longitudinal section through another embodiment,
Fig. 6 shows a view of the valve disc,
Fig. 7 shows different views of a valve actuating element,
Fig. 8 shows a longitudinal section through a further embodiment,
Fig. 9 shows front views of the valve actuating element of Fig. 8, and
Fig. 10 shows a longitudinal section through a further embodiment.

Fig. 1 shows a catheter insertion device 1 having a catheter hub 2 which has a two-part form in the embodiment. A distal hub element 3 of the catheter hub has a holding section 3a in which a catheter 4 is press-fitted. The proximal end of the hub element 3 has an enlarged diameter with regard to the distal end and forms a connecting section with a hub element 5 whose distal end overlaps the proximal end of the hub element 3 and which is provided at its proximal end with a Luer thread 6. Between the two hub elements 3 and 5, a check valve in the form of a valve disc 7 is inserted and is fixed in place by the two hub elements 3 and 5.

In the ready position according to Fig. 1, there is inserted in the catheter hub 2 a needle hub 8 to which a hollow needle 9 is fixed which extends through the valve disc 7 and the catheter 4 so that the needle tip 9a is exposed. Between needle hub 8 and valve disc 7 there is displaceably arranged in the proximal hub element 5 a valve actuating element 10 which has a truncated cone-shaped locating section 10a which serves to open the valve disc 7, as Fig. 3 shows. On the proximal side, a plunger section 10b adjoins the locating section 10a and has a hollow space for receiving a needle guard element 13. In the embodiment shown, the plunger section 10b is formed by two spaced plungers between which the needle guard element in the form of a spring clip 13 is inserted, as shown in the cross-sectional view in Fig. 4.

On withdrawal of the hollow needle 9 from the catheter hub 2, an engaging means 9b (Fig. 2), provided near the needle tip 9a and having the form of a radial projection on the hollow needle which can be formed by light crimping, engages with the outer circumference of a bore in the rear wall 13c of the spring clip 13, so that the spring clip 13 is removed from the catheter hub with the needle 9, while simultaneously the spring arms 13a and 13b of the spring clip cover the needle tip, completely protecting and blocking it. In this separated position shown in Fig. 2, the valve disc 7, due to its elasticity, closes the through-hole for the hollow needle 9 so that no blood can flow out through the catheter 4. As Fig. 6 shows, the valve disc is provided for example with three slits 7a starting from the middle and extending

radially over a short section X, forming elastic flaps 7b therebetween which can be expanded by the hollow needle.

Fig. 3 shows the insertion of a syringe 14 in the catheter hub 2, wherein the neck portion 14a of the syringe comes to abut on the plunger section 10b of the valve actuating element 10 and presses it against the valve disc 7, so that the truncated cone-shaped locating section 10a outwardly displaces the flaps 7b of the valve disc and thereby opens the valve, so that a liquid can be inserted from the syringe 14 into the catheter 4.

The incline of the truncated cone on the locating section 10a and the displacement path of the actuating element 10 relative to the valve disc 7 are designed such that due to the elasticity of the material of the valve disc 7, the flaps 7b displace the locating section 10a to the right in Fig. 3 when the syringe 14 is removed from the catheter hub 2. Hereby, the valve disc 7 is automatically closed, as the position in Fig. 2 shows.

In the hub element 5, there is formed by a shoulder 5a a stop for the actuating element 10, to define the position of the actuating element in the separated position in Fig. 2. Hereby, the truncated cone-shaped locating section 10a lies near the stop 5a, while its distal end abuts on the valve disc 7 as shown in Fig. 2. The radial slits 7a of the valve disc 7 are designed such that in the ready position in Fig. 1, the flaps 7b are bent radially upwards less than in the open position by the locating section 10a in Fig. 3.

As the cross-sectional view in Fig. 4 shows, the two plungers 10b of the valve actuating element 10 are guided in longitudinal grooves 5e of the hub element 5 and they project radially inwards into the bore 5c of the hub element 5, so that they form an abutting surface for the neck portion 14a of the syringe 14. The bore 5c in the hub element 5 is formed slightly conically corresponding to the conical neck portion 14a of a syringe.

On the inner circumference of the bore 5c of the hub element 5, a further shoulder 5b having a smaller diameter is formed, on which the radially outer areas of the spring arms 13a and 13b abut in the ready position in Fig. 1. Hereby, the spring clip 13 is fixed in its position in the hub element 5. When the needle hub 8 with the hollow needle 9 is removed from the catheter hub 2, first the spring clip 13 is held on the shoulder 5b by abutting until the radial projection 9b comes to abut on the rear wall 13c of the spring clip. In this position, the two spring arms

13a, 13b can be released from the shoulder 5b and spring back inwards to cover the needle tip, as Fig. 2 shows, whereupon the spring clip 13 with the hollow needle 9 can be removed from the catheter hub.

In the embodiment according to Figs. 1 to 3, the distal end section of the hub element 5 is shrunk, welded or bonded onto the proximal end section of the hub element 3 after the valve actuating element 10 and the valve disc 7 are inserted in the hub element 5. It is also possible to join the two hub elements 3 and 5 to one another, for example by a thread which is secured against loosening after assembly. The spring clip 13 is inserted together with the hollow needle 9 in the bore 5c of the hub element 5 during assembly, wherein the radially outer areas of the spring arms 13a, 13b snap in at the shoulder 5b under elastic deformation.

Preferably, in front of the shoulder 5b a projection 5b' can be formed in the bore 5c of the hub element, as shown in Fig. 2. Hereby the snap-in and holding effect of the spring clip 13 is increased.

Fig. 5 shows a modified embodiment of the connection of the two hub elements 3 and 5, in which two cylindrical sections 3b and 5d engage in one another. A thread can be provided between these two cylindrical sections. However, it is also possible to bond or weld these two sections.

In this embodiment, the valve actuating element 10 is also modified in relation to the embodiment of Figs. 1 to 3. Fig. 7a shows a side view of the approximately U-shaped actuating element 10 with the spring clip 13 inserted therein. As the side view rotated by 90° in Fig. 7b shows, the locating section 10a is partly flattened on opposite sides so that the width of the plunger sections 10b extends into the locating section 10a. Fig. 7c is a front view from the left in Fig. 7b and shows the flattened structure of the locating section 10a. Fig. 7d is a sectional view along the central line in Fig. 7b. Fig. 7e shows a section through the valve actuating element 10 along the line B-B in Fig. 7d.

Fig. 5 shows the lower half of the valve actuating element 10 corresponding to the view in Fig. 7a, and the upper half in a sectional view rotated by 90° corresponding to Fig. 7b. The shoulder 5a for positioning the valve actuating element 10 in the hub element 5 is hereby formed on the ends of the diametrically opposite grooves 5e (Fig. 4), so that the proximal

ends of the plunger sections 10b abut on the shoulders 5a. Corresponding to the shoulder 5b in Figs. 1 to 3 in the embodiment in Fig. 5, there is formed on the hub element 5 a projection 5f which projects inwards at diametrically opposite positions on the bore 5c of the hub element 5 and fixes the spring clip 13 in the hub element 5 until the spring arms 13a, 13b spring inwards over the needle tip and the spring clip with the hollow needle 9 is removed from the catheter hub.

Fig. 8 shows a modified embodiment having a hollow cylindrical valve actuating element 10 on whose inner circumference a projection 10f is formed for positioning the spring clip 13 inside the valve actuating element 10. Fig. 9a shows a front view of the valve actuating element 10 from the right and Fig. 9b shows a front view from the left in Fig. 8, wherein for locating the neck portion 14a of a syringe 14, in this embodiment radially inwardly projecting ribs 10e are formed which protrude radially into the bore 5c of the hub element 5, as the upper half of the valve actuating element in Fig. 8 shows, in which the sectional view of the lower half of the valve actuating element 10 is shown rotated by 90° in relation to the upper half.

Fig. 10 shows a modified embodiment wherein between the two hub elements 3 and 5 a check valve 17 is inserted, which has a hollow cylindrical section 17b starting from a flange section 17a and abutting on the inner circumference of the hub element 3. From the inner circumference near the flange section 17a there start two opposite flaps 17c, which abut on the outer circumference of the hollow needle 9 in the ready position in Fig. 10. When the needle 9 is removed from the catheter hub 2, the elastically deformed flaps 17c move inwards and close the valve. In this embodiment, an actuating element for opening the valve 17 is not necessary, because the pressure of the fluid from the syringe 14 displaces the flaps 17c radially outwards so that the liquid can flow out through the valve 17. In this embodiment of a check valve, a so-called duck-bill valve is concerned, whose construction is in itself known.

In Fig. 10, in order to allow the spring clip 13 to be held in the catheter hub during withdrawal of the hollow needle 9 from the catheter hub 2 until the radial projection 9b on the hollow needle engages with the rear wall 13c to cover the needle tip, in this embodiment there is formed on the inner circumference of the proximal hub element 5 a projection 5f which extends radially inwards and on which the radially outer areas of the spring arms 13a and 13b come to abut and hold the spring clip until the spring arms spring back radially inwards to cover the needle tip. The inner diameter of the projection 5f is designed only slightly smaller

than the maximum radial dimension at the spring arms 13a and 13b, so that during assembly the spring clip 13 can be inserted by slight pressure into the position in the catheter hub as shown in Fig. 10.

In the embodiment of a catheter insertion device according to Figs. 1 to 9, in the position of the valve actuating element 10 in Fig. 2 the valve disc 7 can be opened by low pressure produced by the syringe 4 for drawing off liquid from the catheter, wherein the elastic flaps 7b are bent upward by the low pressure. In the embodiment of Fig. 10, a drawing-off of liquid from the catheter is not possible, because the duck-bill valve does not open when there is low pressure on the proximal side.

It is convenient to fabricate the check valve in the form of a valve disc 7 or of the flap valve 17 from elastic silicon, while a correspondingly rigid plastic material is used for the hub elements 3 and 5 and for the valve actuating element 10.